# §19. Installation of a Lithium Neutral Beam Probe for Diagnostic on CHS Edge Stochastic Layer

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It has been recognized that plasma properties in the edge region of magnetic confinement devices have key role to determine the global plasma confinement. Understanding and controlling edge plasmas are also important from the point of view of the divertor design for fusion reactors. In non-axisymmetric helical devices, edge magnetic configurations intrinsically include ergodic layer and magnetic island structures. A heliotron type device like the Large Helical Device (LHD) or the CHS has toroidally continuous natural divertor similar to double-null X point structure in tokamaks. However the magnetic lines of force in this region play chaotic behavior forming ergodic region. The separatrix is not clear as that in tokamaks.

Recently sharp pedestal in electron temperature profile is observed in LHD, suggesting edge thermal transport barrier formation. The role of the ergodic layer such as the screening of impurities and fuel neutral particles has been discussed, but no clear physical picture is obtained. It is important to measure the plasma distribution and its parameters in this layer. Measurement of plasma density in the separatrix region is also important from the diagnostic point view. Core plasma density profile is often determined by Abel inversion of multi-channel interferometers. In the case of heliotron type device, the chord inevitably passes the separatrix region. Ambiguity of electron density in this region affects the accuracy of core density profile determination. In order to study plasma structures in the separatrix region as well as the ergodic layer in helical magnetic configuration, two-dimensional diagnostic is essential.

A new LiBP system has been designed and installed on CHS, which can measure two-dimensional plasma structure in the edge plasma region including the separatrix.
A schematic arrangement of the beam injector and the optical detection systems is shown in Fig. 1.

The Li-beam is injected from M-port (located upside of the torus). The beam energy is in the range from 10 to 20 keV with an equivalent neutral beam current of about 0.1 mA. The ion beam is neutralized in the Cs neutralizing cell. The neutral beam diameter is about 20 mm in the CHS vacuum chamber, which is about 2.5 m from the ion gun.

Light collection optics, which detect the light emission from the lithium beam, is installed on the O-port (located outside of the torus). There are eight channel detectors, which can be selected eight observation points by using eight couplers among those. This system is necessary to cope with the different plasma position depending on the position of the magnetic axis.

The injection beam line can be tilted in the major radius direction (±18° from vertical line) so that the edge ergodic layer around the separatrix can be observed two-dimensionally.

Since the signal to noise ratio for the present beam intensity is less than one (S/N < 1), the signal is introduced to phase sensitive detector with 2 kHz beam modulation. The time response is 10 ms at the moment. Figure 2 shows sample signals form the plasma. The upper trace is from the phase sensitive detector and the lower trace is from the direct output from the APD detector with preamplifier. The output signals are to be connected to an A/D converter module of VME standard.

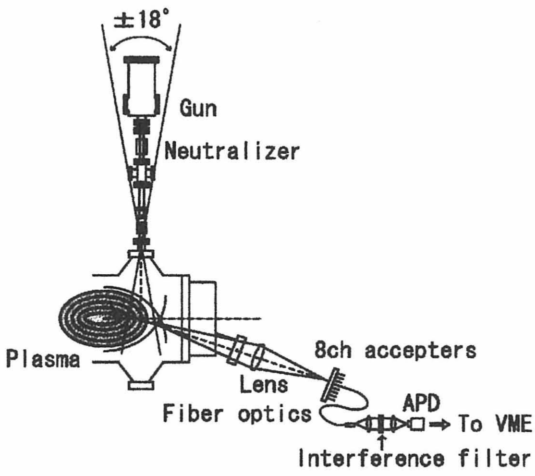


Fig. 1. A schematic arrangement of the beam injector and the optical detection systems.

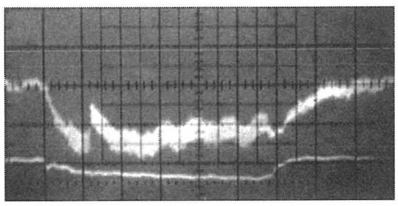

Fig. 2. Sample signals form the plasma. (The time response is 10 ms)